# **Introduction to the Atmosphere**

## **Chapter 3**

# **Atmosphere, Weather and Climate**

## General Composition of the atmosphere

### **Temperature**

### **Pressure**

### **Wind**

### **Moisture**

### **Weather --Flows and Disturbances**

### **Climate -- Zones and Types**

# **Size of the Earth’s Atmosphere**

## **Extends outward at least 6000 miles**

## More than half of the mass of the atmosphere found **below 3.8 miles**

## More than **98% lies with 16 miles of sea level**

## **Humans are creatures of the atmosphere**

# **What is the composition of the Atmosphere**

## **Permanent Gases**

### **Nitrogen and Oxygen make up the 99 % of the atmosphere**

#### 78% Nitrogen

#### 21% Oxygen

### Other 1%

#### Argon .9%

### All other gases .06% equaling .998%

#### Carbon Dioxide .038%

# **Other Significant Gases**

## **Water Vapor**

### **Invisible**

### **Visible**

#### **Clouds**

#### **Precipitation (liquid or solid)**

### Abundant in air overlying warm, most surface areas, like **tropical oceans** measuring up to as much as **4% of the volume of the air mass**

### Over **deserts or polar regions** it would make up **less than 1% of the volume**

## **Carbon Dioxide (CO2)**

## **Significant to the climate because of its ability to absorb infrared radiation**, which helps warm the lower part of the atmosphere

## **Distributed evenly throughout the lower atmosphere**

## **Increasing during the last century**

## **at a rate of about .0002 percent**

## **Increased levels of Carbon Dioxide are causing the lower atmosphere to produce somewhat unpredictable climate changes (global warming)**

## Another **minor vital gas** in the atmosphere is **Ozone**

## Mostly **concentrated in the Ozone layer**

### Between **9 to 30 miles above sea level**

### **Ozone is excellent as an absorber of ultraviolet solar radiation** and its deadly effects.

## Other **variable gases** include

### **Carbon monoxide, sulfur dioxide, nitrogen oxides, and various hydrocarbons**

### **All hazardous to life and may possibly effect the climate**

# **Particulates (Aerosols)**

## **Large nongaseous particles** in the atmosphere

### **Mainly liquid water and ice**

#### **Clouds, rain, snow, sleet, and hail**

### **Dust particles large enough to be visible**, but too heavy to fall to the ground

### **Smaller particulates are invisible to the naked eye**, may also be suspended in the atmosphere

## **Found near their origin, either urban areas, or the natural condition that caused the particulate**

# **Effects on Weather and Climate**

## Many of the **particulates are hygroscopic (absorbs water)**

### The **water vapor condenses around the particulates as they float by**

### **Accumulation of water vapor molecules is a critical step in cloud formation**

## **Some either absorb or reflect sunlight, thus decreasing the amount of solar energy** that reaches Earth’s surface

# **Structure of the Atmosphere**

## **Lower thermal layers** of the atmosphere

### **Troposphere and Tropopause**

#### **Lowest level**, closest to sea level

##### **11 miles at equator to 8 miles at poles**

##### **Deepest over the tropical regions**

##### **Shallow over the poles**

##### **Varies with the passages of warm and cold air**

##### Layer of **Weather** and **Climate**

##### The temperature **decreases** with the **increase** of altitude

### **Stratosphere and Stratopause**

#### **Extends from 11 miles above sea level to 30 miles above sea level**

#### The temperature **increases** with the increase of altitude

## **Upper thermal layers** of the atmosphere

### **Mesosphere and Mesopause**

#### Begins at 30 miles and ends 50 miles above sea level

#### Temperature **decreases** with an increase in altitude

### **Thermosphere**

#### Begins at 50 miles and gradually extends out

#### Temperature **increases** to an altitude of 125 miles about sea level

### **Exosphere**

#### Outer most portion of the atmosphere

#### Blends with interplanetary space

#### **No concept** of temperature

# **Warm Layers/Cold Layers**

## **Warm Layers**

### **Layers that have a specific source of heat**

#### **Troposphere:**

##### The Earth is the source of heat for this layer

#### **Top of the Stratosphere**:

##### The Ozone layer which is found within this layer absorbs ultraviolet rays, thereby warming this layer

## **Cold Layers**

### Layers that **don’t have the warming sources**

# **Two other Vertical Compositional Layers**

## **Ionosphere**

### **40 to 250 miles above sea level**

### **Deep layer of electrically charged molecules and atoms**

### Aids in the **reflecting of radio waves back to earth**

### Is also known for its ***aurora borealis displays* or the Northern Lights**

### Found in the **Thermosphere**

## **Ozonosphere**

### **9 to 30 miles above sea level**

### Gets its name because the **concentration of ozone is at its highest point**

### Found in the Stratosphere

# **Pressures**

## **Atmospheric pressures are simply the “weight” of the overlying air**.

## The taller the column of air the greater the pressure

### So at **sea level, the column of air above is longer thus the air pressure is higher, and the air is denser**

### At a **high altitude there is a smaller column of air, so the air pressure is lower and the air is less dense**.

## **The decrease in air pressure decreases with altitude but not at a constant rate**

# **Human-Induced Atmospheric Change (What have we done?)**

## **Depletion of the Ozone Layer**

## **Hole in the Ozone Layer**

### **Chlorofluorocarbons most problematic chemicals** used by humans that depleted the Ozone

### **Thinning of the Ozone Layer allows for Ultraviolet rays to reach the surface of the earth**

### In the polar areas of the earth (Antarctica), the ice crystals create a place for chlorine based molecules to form. In the spring they trigger a catalytic reaction and the Ozone is depleted even more than in the other latitudes

# **Air Pollution**

## Smoke

## Sulfur Compounds

## Nitrogen Compounds

## Photochemical Smog

## **Consequences of Anthropogenic Air**

### **Pollution**

### **Damages our health**

### **Damages the plant life**

# **Weather**

## **Weather…**

### **Short-run atmospheric conditions that exist for a given time in a specific area**

### The **sum of temperature, humidity, cloudiness, precipitation, pressure, winds, storms, and other variables for a short period of time**

### **Weather is in an almost constant state of change**

# **Climate**

## **Climate……**

### The **generalized variations of the weather**

### The **aggregate of day-to-day weather conditions of a long period of time.**

### Has **averages, variations and extremes**

## **Weather and Climate have direct and obvious influences on agriculture, transportation, and human life, and the physical land**

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# **Four Elements of the Weather and the Climate**

* **Temperature**
* **Wind**
* **Pressure**
* **Moisture**

# **Controls of the Weather and Climate**

## **Latitude**

## **Distribution of Land and Water**

## **General Circulation of the Atmosphere**

## **General Circulation of the Oceans**

## **Altitude**

## **Topographic Barriers**

## **Storms**

# **The Coriolis Effect or Force**

## **Appearance of all things drifting sideways** as a result of the Earth’s rotation

## Why? If a rocket is shot directly at New York, by the time the rocket arrives at New York, the Earth has rotated and the rocket seems to have **“drifted”**

## **Applies to any freely moving object**

# **Four Basic Points of the Coriolis Affect**

## **Regardless of the initial direction of motion**, any freely moving object appears to deflect to the **right** in the **Northern Hemisphere** and to the **left** in the **Southern Hemisphere**

## The apparent deflection is **strongest** at the **poles** and **decreases progressively toward the equator** where there is zero

## The Coriolis affect is **proportional** to the **speed** of the object, so a **fast-moving object is deflected more than a slow one**

## The Coriolis affect **influences direction of movement only**… it has **no effect on speed**

# **Major importance of the Coriolis Effect**

## **All winds** are affected by the Coriolis Effect

## **Ocean currents** are also deflected by the Coriolis Effect

## The **Coriolis Effect may or may not** affect the direction of the flow of the water as it drains down the sink